Space Place: Make a Balloon Powered Nanorover

NASA SUMMER OF INNOVATION

UNIT
Engineering – Design Process

GRADE LEVELS
7^{th} – 9^{th}

CONNECTION TO CURRICULUM
Science, technology

TEACHER PREPARATION TIME
40 minutes

LESSON TIME NEEDED
1 hour *Complexity : Moderate*

LESSON DESCRIPTION

Design and build a robotic rover with cardboard and a balloon**.**

OBJECTIVES

Students will:

- Design a rover using patterns and materials provided.
- Investigate the engineering challenges of wheels, speed and friction.
- Examine the concept of a prototype in engineering.
- Demonstrate the use of potential and kinetic energy.
- Explain ways the rover can be used in space travel and exploration.

NATIONAL STANDARDS

National Science Education Standards (NSTA)

Science as Inquiry

- Understanding of scientific concepts
- An appreciation of "How we know" what we know in science
- Skills necessary to become independent inquirers about the natural world
- The dispositions to use the skills, abilities and attitudes associated with science.

Physical Science Standards

- Motions and Forces
- Transfer of Energy

Science and Technology Standards

- Abilities of technological design
- Understanding about science and technology

ISTE NETS and Performance Indicators for Students (ISTE)

Creativity and Innovation

- Apply existing knowledge to generate new ideas, products, or processes
- Use models and simulations to explore complex systems and issues

Research and Information Fluency

- Plan strategies to guide inquiry
- Process data and report results

Critical Thinking, Problem Solving, and Decision Making

- Plan and manage activities to develop a solution or complete a project

MATERIALS

- *3 Large* Styrofoam meat trays *(at least 9 x 11 inches)*
- Ruler
- *4 Flexible plastic drinking* straws
- *3 Small (10-inch)* bamboo skewers *(for making shish-ka-bobs)*
- *7 Pea-sized blobs of* clay *or* Play-doh©*, or seven small* gum drops
- *1 Large wire* paper clip
- *1 Small (7-inch) party* balloon
- *1 Small* rubber band
- *Transparent* tape *(not the removable kind)*
- *Printed* pattern, decals, and wheel treads *(all on 2 sheets of paper)*

MANAGEMENT

Read the directions carefully and gather all of the materials. Build a sample rover. Have students work in small groups no larger than 3 in a group.

CONTENT RESEARCH

The **nanorover** was designed to attach to a spacecraft going to Asteroid 4660 Nereus in 2002. Just a couple of inches high ("nano" meaning very tiny) and built by the U.S. National Aeronautics and Space Administration's Jet Propulsion Laboratory, the rover was designed to explore the surface of the **asteroid** and take pictures. Read the Information on the nanorover and the intent of using the nanorover on the asteroid mission. http://spaceplace.nasa.gov/en/kids/muses3.shtml

There are several additional activities for this lesson on the Space Place.

Key Concepts:

Asteroid: Rocky space objects varying in size between a few feet wide to a few hundred miles wide. Most orbit between Mars and Jupiter.

MUSES-CN- Mission for nanovers that was scrubbed due to cost and weight.

Nanorover: The robot is a small, motorized vehicle that is just a couple of inches high called a "nanorover" ("nano" meaning very tiny). The rover will explore the surface of the asteroid and take pictures.

Robot: A machine or device that operates automatically or by remote control

Read more: http://www.answers.com/topic/robot#ixzz1K07FOktG

LESSON ACTIVITIES

Build a Nanorover – Use cardboard and a balloon to power a rover across the floor.
http://spaceplace.nasa.gov/en/kids/muses_nanorover.pdf

Be glad you are not a Cyclops: Stereo vision http://spaceplace.jpl.nasa.gov/en/kids/urbie_action.shtml

MARSDIAL: Show Me the Way to Go Home
http://marsrovers.jpl.nasa.gov/classroom/marsdial/activity02.html

RELATED RESOURCES

Asteroid Lithograph: http://www.nasa.gov/pdf/62205main_Asteroids.Lithograph.pdf

Rover photo gallery: http://www.nasa.gov/mission_pages/mer/multimedia/gallery/gallery-index.html

Rovers: Life on Mars http://marsrovers.jpl.nasa.gov/home

Robotics Alliance webpage: http://robotics.nasa.gov

Send a postcard to Spirit: http://beamartian.jpl.nasa.gov/spiritpostcards

Lunar rovers and the future of robotic rovers website: http://lunarscience.arc.nasa.gov/articles/nasa-budget-to-fund-robotic-lunar-exploration

Mars rover YouTube: http://www.youtube.com/watch?v=UyM1bgKWzngONS

DISCUSSION QUESTIONS

1. Look at your rover and discuss list the features found on cars designed for use on earth. What kinds of earth vehicles are similar to rovers? (*Snowmobiles, tanks, dune buggies, and all-terrain vehicles are similar. They all have good traction, are very stable, have powerful engines, and don't require a roadway.)*

2. What features are needed for rovers that are unique to their mission? *(Kids see that engineers face special design challenges when developing equipment to be used in space.*

3. Why do engineer build prototypes? *(With a prototype, kids can quickly see what's working and what isn't. They then know where to make improvements.)*

4. How does friction affect your rover? How can you overcome friction in your design? *(To be efficient, there needs to be minimal friction between the axle and the axle hole in the cardboard. To move, there needs to be lots of friction between the wheels and the ground.)*

5. How did the rover use potential and kinetic energy? *(Potential energy is energy that is stored. Kinetic energy is the energy of motion. Winding the front wheels increased the amount of potential energy stored by the rubber band. When the wheels spin, this potential energy is turned into kinetic energy, and the axle and wheels turn.)*

ASSESSMENT ACTIVITIES

Have students make presentations of their rovers with an explanation of the design challenges they faced building them. Data showing speed, potential and kinetic energy also should be presented. An explanation of how rovers are used in space exploration should be included.

ENRICHMENT

1. Determine the effect of friction.
2. Graph the effect of increased potential energy on the distance traveled. (Amount of air in the balloon)
3. Test the effect of different wheels on the rovers.
4. Report on the Three Mars rovers and their missions.